इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 15584 (2005): Medical X-ray films [MHD 18: Imaging and Radiotherapy Equipment]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

भारतीय मानक

मेडिकल एक्सरे फिल्म

Indian Standard

MEDICAL X-RAY FILMS

ICS 11.040.50

© BIS 2005

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 2005

Price Group 6

Inorganic Chemicals and Photographic Materials Sectional Committee, CHD 1

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Inorganic Chemicals and Photographic Materials Sectional Committee had been approved by the Chemical Division Council.

Medical X-ray film market in India is very high and growing further rapidly. Photographic product manufacturing technology is a closely guarded preserve of a few manufacturers in the world.

Majority of the film is imported. The importers fall into two categories : traders of finished goods and the converters of semi-finished medical X-ray film called Jumbo Rolls. The former who constitute around 20 percent of the total import, import packed X-ray film of different sizes and supply to the customers whereas latter import Jumbo and cut into various sizes and subsequently pack in their plant before supplying to the customers.

The medical X-ray films available today are polyester films (PET).

The basic quality parameters which are desirable in X-ray films are:

a) Qualitative response of the emulsion to a standard set of exposure and processing conditions in terms of speed, contrast and density.

b) Minimum variability in response to exposure conditions in a custom built equipment, simulating the quantum and type of energy that would be received by medical X-ray film in practical condition.

c) Minimum variability in sensitometric properties with respect to processing, processing chemistry and recommended drying condition.

d) Stability under recommended condition of packing, storage and handling.

In the absence of any National Standard, Indian manufacturers and multinational firms who are importing are following different specifications like ANSI, DIN, ISO or their own specification.

In the formulation of this standard, considerable assistance has been derived from the following:

ISO 5-2 : 1991 Photography — Density measurements — Part 2 : Geometric conditions for transmission density

ISO 5-3 : 1995 Photography — Density measurements — Part 3 : Spectral conditions

ISO 5-4 : 1995 Photography — Density measurements — Part 4 : Geometric conditions for reflection density

ISO 554 : 1976 Standard atmospheres for conditioning and/or testing — Specifications

ISO 4090 : 2001 Photography — Medical radiographic cassettes/screens/films and hard-copy imaging films — Dimensions and specification

ISO 9236-1 : 1996 Photography — Sensitometry of screen/film systems for medical radiography — Part 1 : Determination of sensitometric curve shape, speed and average gradient

ISO 9236-3 : 1999 Photography — Sensitometry of screen/film systems for medical radiography — Part 3 : Determination of sensitometric curve shape, speed and average gradient for mammography

ANSI PH2.19 - 1990 Photography (sensitometry) — Density measurements — Geometric conditions for transmission density

ANSI PH2.9 - 1974 Methods for the sensitometry of medical and dental X-ray films

(Continued on third cover)

Indian Standard

MEDICAL X-RAY FILMS

1 SCOPE

This standard prescribes the requirements and methods of sampling and tests for double sided emulsion coated medical X-ray films, blue or green sensitive used for general purpose radiography.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
4905 : 1968	Methods for random sampling
9644 : 1980	Specification for sizes of film for medical radiography

3 TERMINOLOGY

3.1 Defects — For the purpose of this standard, the following definition of the defects shall apply.

3.1.1 *Visual Defects*

a) *Air bubble* — A transparent spot.

b) *Air bubble line* — A continuous white line.

c) *Air bubble streak* — A transparent spot with a black concentric ring with a small white or black tail.

d) *Coating miss or uncoated area* — The area of the film without any emulsion coating.

e) *Comet mark* — A white or black comet like appearance due to repellency of emulsion to the base.

f) *Streak mark or streak patch* — A dark patch or tail like mark in the film.

g) *Tape bit sticking* — A PVC or polyester tape bit seen on the film.

h) *Scratches* — Continuous or discontinuous shining line on the surface of the film which appear as black/white lines after processing.

j) *Knurling* — Without emulsion coating and knurling impression along the length at both edges of the base of the film.

k) *Step cut and damage at corner round* — Improper cutting of the edge of the corner round of film. (Medical X-ray sheets are corner rounded for easy movement in between the roller of processing machine).

m) *Cutting/slitting quality* — The edge of the film shall be smooth and without any blemishes.

3.1.2 *Latent Defects (Defects Seen After Chemical Processing)*

a) *Fog* — Blackness (unwanted density) present in the film apart from the allowable minimum fog level (acceptable level).

b) *Static mark* — The accumulated electrostatic charge discharges and resembles the object like tree, sunrise, spot-line type.

c) *Band of higher density* — Band with higher blackness present in a particular area of the film.

d) *Band of lower density* — Band with lesser blackness present in a particular area of the film.

e) *White line* — A line of lesser density in a particular area of the film.

f) *Scratches* — Continuous and discontinuous shining lines on the surface of the film which appear as black line after processing.

g) *Pressure mark* — Black or white spot or patch appear on film due to stress.

h) *Nail mark or kink mark* — A white or black crescent mark with a dent.

j) *Rubbing* — Marks at the direction which appears black/white lines after processing.

3.2 Base + Fog — The blue base density and acceptable inherent emulsion fog is called base+fog.

3.3 Air Kerma (K) — That energy which is transferred by X-rays to air molecules divided by the mass of the air in that volume where energy is released is termed as air kerma (K). The unit is Gray (Gy). 1 Gray is the absorbed dose of X-radiation in 1 kg of air, which produces charged particles and imparts 1 J of initial kinetic energy to those charged particles (1 Gy = 1 J/kg of air equivalent to 114.5 R or equivalent to 0.029 5°C/kg).

3.4 Net Density — Net density in this context is the density of an exposed and processed film minus the density of an unexposed and processed sample of the film.

3.5 Sensitometric Curve — Plot of the density of the processed photographic film as a function of logarithm of the exposure in terms of air kerma (K).

3.6 Speed (S) — Speed is the quantitative measure of the response or sensitivity of the film or screen/film combination to X-ray for specified condition of exposure, processing and density measurement. It is the reciprocal of the exposure required to produce a density of 1.0 above the base + fog density under the standard condition of exposure and processing.

3.7 Absolute Speed — Absolute speed of a screen-film system or a film is defined as the reciprocal of the air kerma (in Gray) required to produce a density of 1.0 above base + fog.

3.8 Relative Speed — Relative speed of a screen-film system, a pair of screen or a film is defined as the reciprocal of the relative air kerma (in Gray) required to produce a density of 1.0 above base + fog compared with that obtained by means of a standard screen-film system, standard pair of screen or a standard film. In other words the relative speed can be obtained by simply dividing the absolute speed by the speed of the standard.

3.9 Average Gradient ($\bar{G}$) — The slope of the straight line joining two specified points on a sensitometric curve. To calculate the $\bar{G}$ a triangle is constructed using defined points at net density 0.25 to net density 2.0.

3.10 Cassette — The X-ray film is placed in light tight film holder/cassette. The cassette encloses two intensifying screens.

3.11 Half Value Layer (HVL) — The half value layer of aluminium is the thickness of aluminium slab which when placed in the X-ray beam between the focus and the detector, the exposure rate will become half of its original value at specified tube voltage and current.

3.12 Artifact — Any visual defects observed on a film after processing under standard condition.

4 REQUIREMENTS

4.1 Description — It shall be double sided emulsion coated film for medical radiography in sheet form of various sizes as per IS 9644.

4.2 Material of the Base — Material used as base shall be polyethylene terephthalate (PET) resin and blue or clear base at the option of purchaser. Base density of blue base shall be 0.10 ± 0.01.

4.3 Defects — The film shall be examined for finish and defects and it shall be free from visual and latent defects.

4.4 Dimensional Stability — The nominal and actual size of films shall be mentioned under specified condition of 23 ± 2°C and 50 ± 5 percent RH and shall conform to the size given in Table 1 of IS 9644.

4.5 Squareness of Sheet — Neither diagonal of any sheet of the film shall exceed the diagonal of a rectangular sheet of the appropriate maximum length and width nor shall it be less than the diagonal of a rectangular sheet of the appropriate minimum length and width.

4.6 Corner Rounding — The four corners of the cut sheets shall be rounded and they shall not have any steps and sharp features.

4.7 Interleaving Paper — If needed for the protection of the film against environmental condition, it shall be interleaved with a minimum of 50 GSM yellow/white interleaving paper and the interleaving paper shall be photographically inert.

4.8 X-ray films shall also meet the requirements as given in Table 1.

4.9 Speed — Speed in SI Unit (Gy^{-1}) shall be declared by the manufacturer indicating the minimum value and the screen used. These shall be measured by the method given in Annex B.

4.10 Radiography — The medical X-ray films shall be got tested for image clarity, sharpness and contrast as per the methods given in Annex C. The requirement of the above parameters is as follows. The contrast shall be 2.0 - 3.0. Sharpness and image clarity are specified in terms of resolution and shall be at least 4 line pair/mm (lp/mm).

4.11 Accelerated Ageing Test (Type Test) — A sample carton of films in its original package shall be kept in environmental chamber at 50 ± 2°C and 50 ± 5 percent RH for a period of seven days continuously. At the end

Table 1 Requirement for Medical X-Ray Films

(*Clause* 4.8)

Sl No. (1)	Characteristic (2)	Requirement (3)	Method of Test, Ref to Annex (4)
i)	Thickness of base, microns	185 ± 20	A
ii)	Base + Fog density	0.18 ± 0.02	B
iii)	Maximum density (D_{Max}), *Min*	2.25	B
iv)	Average gradient ($\bar{G}$)	2.0 - 3.0	B
v)	Uniformity in optical density, *Max*:		
	a) Along the direction of X-ray tube	0.15	B
	b) Perpendicular to X-ray tube	0.10	B

of the period the carton shall be normalized at 23 ± 2°C and 50 ± 5 percent RH for 24 h and then shall be tested. At least three specimens shall be examined for sensitometric test for conformity to the requirement in Table 1.

5 PACKING AND MARKING

5.1 Packing

For all sizes the number of sheets of film for medical X-ray use in single packing shall be 25, 50 or 100 sheets. These shall be placed in light proof black pouches made of low density polyethylene film of at least 175 µ thick and heat sealed to prevent ingress of light and moisture. Such pouches shall be put in light tight cartons and securely sealed with adhesive tape.

5.2 Instruction Manual

The supplier shall provide instruction manual giving details of processing, storage and handling along with each packing.

5.3 Marking

Each package shall be legibly and indelibly marked with the following information:

a) Name of the manufacturer or trade-mark, if any;

b) Normal size of film with smaller dimensions shown first, in mm;

c) Number of sheets;

d) Date of expiry;

e) Instruction regarding storage conditions (temperature and relative humidity) and 'stack vertically' should be shown boldly;

f) Emulsion number;

g) Blue/Green sensitive film; and

h) Speed of the film : slow/medium/fast/ultra fast/latitude type to facilitate selection of film/screen combination.

5.3.1 *BIS Certification Marking*

The material may also be marked with the Standard Mark.

5.3.1.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of the conditions under which the license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from Bureau of Indian Standards.

6 SAMPLING

The method of drawing representative samples of the material, the number of tests and the criteria for conformity shall be as prescribed in Annex D.

ANNEX A

[*Table* 1, *Sl No.* (i)]

DETERMINATION OF THICKNESS OF BASE

A-1 PROCEDURE

An unexposed sample of the film (without developing) shall be fixed under standard processing conditions (*see* **B-3.5**) to remove silver halide on the film. This is washed, dried and the thickness is measured by suitable micrometer.

ANNEX B

[*Clause* 4.9; and *Table* 1, *Sl No.* (ii) *to* (v)]

DETERMINATION OF BASE + FOG DENSITY, MAXIMUM DENSITY, AVERAGE GRADIENT, UNIFORMITY AND SPEED

B-1 GENERAL

Sensitometric curve shape is purely depending on film. Sensitometric curve plotted using light sensitometry; screen sensitometry and X-ray sensitometry for a film are reported to be coinciding. For the determination of sensitometric curve shape, irradiation of the screen/film combination need be measured in relative units. Both the average gradient and the speed are measured from the sensitometric curve. Further, the speed of film expressed in terms of reciprocal of ergs. cm^{-2} or $J.m^{-2}$ may not sound much useful to a radiologist for deciding to select a suitable film/screen combination. The measurement of absolute speed of a film is extremely time consuming in spite of its limited practical applications. Hence relative speed with respect to an accepted standard system (Film/screen/film holder/ processing combination) using an intensity scale X-ray sensitometry was found to be more user oriented and easy to measure when a large number of specimen samples are involved. A calcium tungstate screen ($CaWO_4$) of suitable speed class with a blue sensitive film or a rare earth screen (Gd_2O_2S : Tb) of suitable speed class with a green sensitive film loaded in a proper film holder serve as standard system.

Five different techniques are offered differing in beam qualities and fraction of scattered radiation to simulate five different scenarios of the practice, namely, extremities, skull and pelvis, lumber spine and colon, low kVp chest radiography and high kVp chest radiography.

B-2 APPARATUS

B-2.1 X-Ray Sensitometry — The X-ray sensitometry consists of following apparatus.

B-2.1.1 *A General Purpose Diagnostic Type X-Ray Unit* — The generator shall be of 6 pulse, 12 pulse or multi-pulse (high frequency) type.

B-2.1.2 *X-Ray Monitoring Instrument* — It consists of a monitoring chamber and an electrometer.

B-2.1.3 *X-Ray Measuring Instrument* — It consists of a measuring chamber and an electrometer.

B-2.1.4 *Film Holder (Cassette)* — The front of the cassette shall be constructed of low atomic number plastic (preferably carbon fibre) and shall not absorb more than 2 percent of the incident radiation. It should ensure perfect screen film contact and no light leakage.

B-2.1.5 *Screen* — A calcium tungstate screen ($CaWO_4$) of suitable speed class for blue sensitive film and a rare earth screen (Gd_2O_2S : Tb) of suitable speed class for green sensitive film shall be used.

B-2.1.6 *Test Phantom* — The test phantom consists of six polymethylmethacrylate (PMMA) slabs, each 25 mm thick × 300 mm^2. The six slabs are arranged in 3 pairs. Between the upper pair of slabs a 1 mm thick and 300 mm^2 aluminium sheet is sandwiched. Between the middle pair of slabs also a similar 1 mm thick aluminium sheet is sandwiched. Between the lower pair of slabs a 2 mm thick aluminium sheet is sandwiched. The upper and lower pairs of slabs are separated by a gap of 54 mm (*see* Fig. 1).

B-2.1.6.1 *Phantom for extremities* — The bottom pair of slabs with 2 mm thick aluminium sheets sandwiched between them alone represents test objects for extremity radiography.

B-2.1.6.2 *Phantom for chest radiography* — The upper and lower pairs of slabs along with the sandwiched aluminium sheets with an air gap of 54 mm separating them represent phantom for chest radiography.

B-2.1.6.3 *Phantom for skull and pelvis* — All six slabs together but without the aluminium sheet in the middle pair of slabs represent the test object for skull and pelvis radiography.

B-2.1.6.4 *Phantom for lumber spine and colon* — All three pairs of slabs with corresponding aluminium sheets sandwiched between each pair together represents test object for lumber spine and colon radiography.

B-2.1.7 *Densitometer* — It shall be a standard diffuse transmission densitometer with white light source having accuracy of $\Delta D/D = \pm 0.01$ or $\Delta D = \pm 0.01$ whichever is greater.

B-2.1.8 *Diaphragms (Lead Collimator)* — Diaphragms with smallest dimensions 15 mm and shielding thickness not less than 3 mm shall be incorporated near the film cassette.

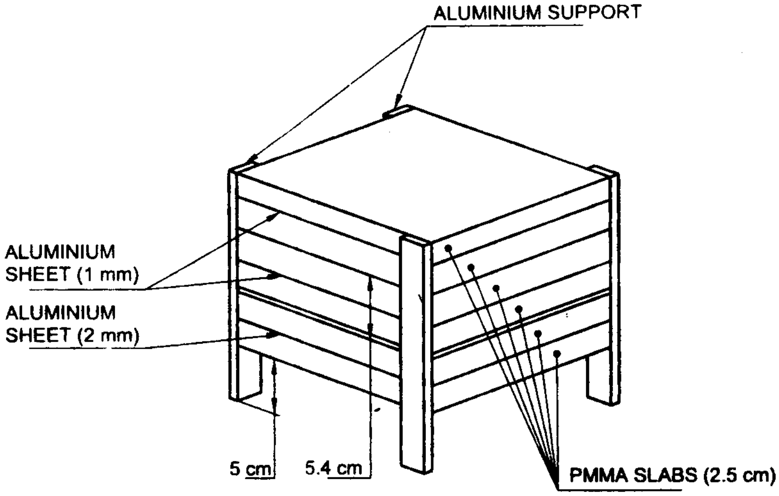


FIG. 1 STANDARD TEST PHANTOM FOR MEASUREMENT OF SPEEDS OF SCREEN-FILM SYSTEM

B-2.2 Light Sensitometer — For process control a light sensitometer (single flash or double flash) with blue and green emitting light source shall be used.

B-3 PROCEDURE

B-3.1 Safe Light

To eliminate dark room fog all films shall be kept in total darkness during handling and processing.

B-3.2 Cassette and Film Storage

The film and screen shall be stored according to the manufacturers' recommendations. Before and during the exposure the film and screen shall be maintained at 23 ± 2°C and 50 ± 5 percent RH.

B-3.3 X-Ray Beam Quality

For the determination of sensitometric curve shape, any one of the five beam qualities specified in Table 2 shall be used. The X-ray tube potential shall be measured and set within an accuracy of ±5 percent. The half value layer in aluminium (1100 alloy) shall be measured by keeping the detector at least 100 cm away from the focus and filters midway between the detector and the focus. The tube voltages given in Table 2 are recommended as starting values. For each of the techniques to be tested, tube voltage shall be adjusted until the measured half value of aluminium is within ±2 percent of the value given in Table 2.

B-3.4 Exposure Conditions and Geometry for Determination of Sensitometric Curve

A typical geometric set up of measuring arrangement is given in Fig. 2. It represents high scatter exposure conditions (without grid). A lead sheet 0.25 mm thick shall be provided at 20 cm away from the backside of the cassette for kVp less than 110. In case of kVp above 110, the lead backing sheet should be placed at least 45 cm away from backside of the cassette. The focus to film distance indicated as 'X' shall be 1.8 m for the chest exposure and 1 m for all other exposure techniques. The exposures for determination of sensitometric curve shall be non-intermittent, intensity scale. The exposure times shall be uninterrupted and shall be in the range of 20 ± 10 ms to 200 ± 10 ms and shall be kept constant for all exposures.

The X-ray beam shall be collimated such that it will fully irradiate the test object placed in front of the cassette.

Table 2 Exposure Techniques and Beam Quality Specifications
(*Clause* B-3.3)

Sl No. (1)	Technique (2)	kVp (3)	HVL mm Al (4)	Exposure Time ms (5)	Exposure Conditions (6)
i)	Extremity	60	2.2	100	No grid
ii)	Skull and pelvis	70	2.6	200	Grid
iii)	Chest (low kVp)	80	2.7	100	No grid
iv)	Lumber spine and colon	90	3.0	200	Grid
v)	Chest (high kVp)	120	3.8	20	Grid

The intensity is modified either by change in the distance (inverse square law) or by change in tube current (mA). For plotting sensitometric curve the film is subjected to at least 20 different exposures equally distributed on a logarithmic scale, which produces net densities 0.1-2.1. The intensity in terms of air-kerma (Gy) that the film is subjected to shall be measured using a measuring chamber placed at the film plane (without the film). In order to find D_{Max} one may have to increase tube current. In which case it shall be verified that the higher tube current does not change the beam quality.

In case of low scatter exposure conditions (with grid) the test phantom is placed close to the X-ray tube.

B-3.4.1 *Determination of Exposure Levels*

A monitoring chamber shall be mounted near the X-ray tube and a measuring chamber at the location of the cassette. These shall be used to determine the exposure level for each exposure specified in **B-3.4**.

The reading M_1 of the monitoring chamber for each exposure in **B-3.4** is noted. Immediately following each exposure of **B-3.4** the cassette is removed and the measuring ionization chamber is placed at the same position and the exposure repeated. The reading M_2 of the monitoring chamber and the reading X in roentgen of the measuring chamber is noted. The exposure E in roentgen of the film-screen combination shall be calculated from the formula:

$$E = (M_1/M_2).X$$

$E/114.5$ will give the exposure in Gray (Gy).

B-3.5 Processing

Either manual or automatic processing may be used. Processing should be carried out in accordance with the film manufacturer's recommendations. However, the following processing information and accuracy shall be maintained:

a) Trade designations of all chemicals, if proprietary: otherwise the formulas;

b) Temperature of the developer to within ±0.3°C;

c) Temperature of other solutions to within ±0.5°C;

d) Immersion times in the various solutions to within 3 percent;

e) Whether the developer is fresh or seasoned, if seasoned, the type and amount of films developed for seasoning, and the replenishment procedure;

f) Agitation specifications, in terms of volume of solution re-circulated or rate at which a gas is used;

g) Drying temperature to within ±10°C; and

h) Trade designation of processing equipment.

B-3.5.1 *Delay for Processing*

In order to minimize any effect due to latent image instability or process variability, all film samples shall be processed together, neither less than 30 min nor more than 4 h after exposure. During exposure and between exposure and processing, the temperature of films shall be maintained at 23 ± 2°C and moisture content shall be such that the films will be in equilibrium at a relative humidity of 50 ± 20 percent

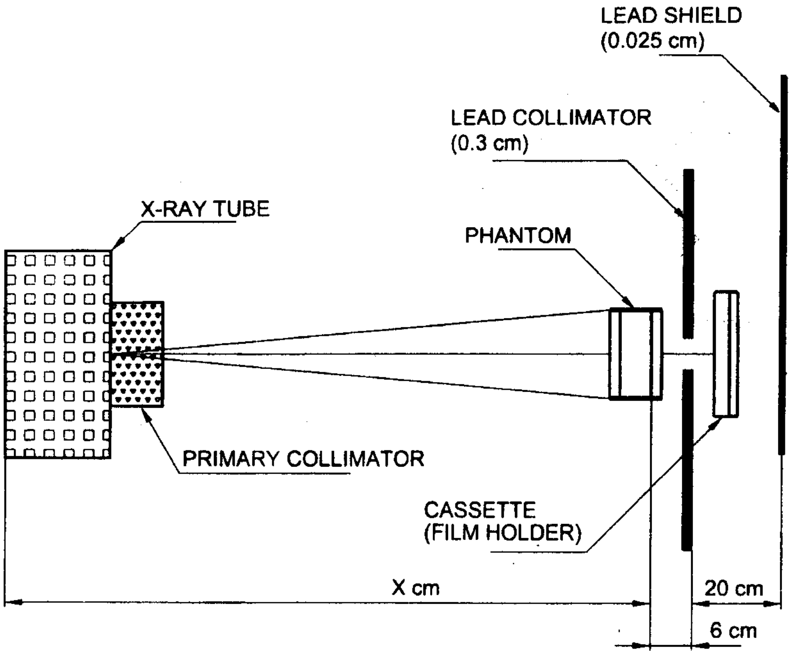


FIG. 2 EXPOSURE GEOMETRY USED FOR PLOTTING H & D CURVE

B-3.6 Measurement of Diffused Transmission Density

Density of the processed and dried films shall be measured by a standard diffuse transmission densitometer with an accuracy of $\Delta D/D = \pm 0.01$ or $\Delta D = \pm 0.01$ whichever is greater.

B-3.7 Determination of Base and Fog Density

An unexposed sample of film from the same sample box as that tested for thickness of base and sensitometric properties shall be processed under standard condition simultaneously with those samples taken to plot sensitometric curves. The density measured shall be the base + fog density.

B-3.8 Plotting the Sensitometric Curve

The diffused transmission density (*D*) as ordinates shall be plotted against their corresponding logarithm to the base 10 of air kerma (log K) expressed in grays (Gy) as abscissa and a smooth curve shall be drawn through the plotted points, K shall be expressed in gray (Gy) (*see* Fig. 3). The scale units on the graph paper for the abscissa and the ordinate shall have equal spacing. For brevity, the diffused transmission density will be referred to as density and symbol *D* is used in the standard.

B-3.9 Maximum Density (D_{Max})

The density of one of the film exposed as per **B-3.4** with maximum mA shall be measured and recorded as maximum density (D_{Max}).

B-3.10 Determination of the Average Gradient, $\overline{G}$

The average gradient $\overline{G}$ is given by: $\overline{G} = (D_2 - D_1)/(\log K_2 - \log K_1)$ where D_2 and D_1 are net densities having the values 2.0 and 0.25 respectively and K_2 and K_1 are the corresponding relative values of air kerma extracted from the sensitometric curve.

B-3.11 Determination of Speed

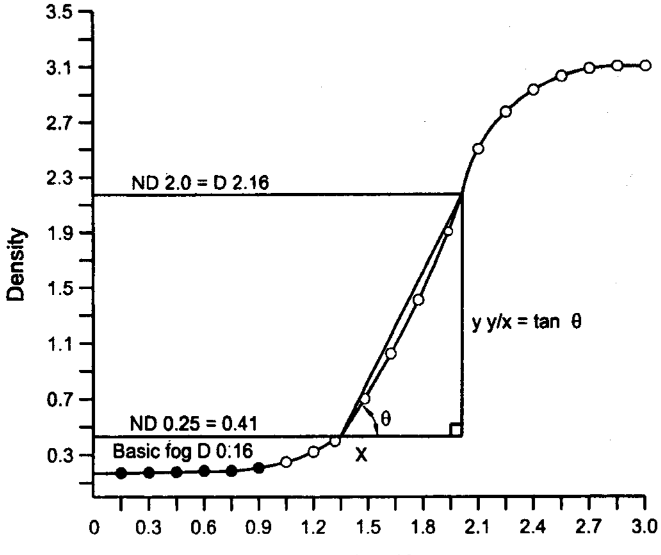
From the graph the air kerma needed to produce a density of 1.0 above base + fog is found out. The reciprocal of this exposure is the speed of the screen-film combination exposed. By conducting repeated measurement the absolute speed of the standard system of screen film combinations is found out. By exposing the unknown film in place of the earlier one and finding the relative air kerma needed to produce a density of 1.0 above base + fog one can find the relative speed of the new film by simply dividing the absolute speed by the speed of the standard.

B-3.12 Check for Artifact

A sample film taken from each box is tested for artifact. The samples are loaded in standard screen cassette and exposed to 80 kVp X-ray under a clear plastic (PMMA) sheet of 5 cm thickness. The cassette shall be placed on the table top at a focus to film distance of 100 cm and markings shall be placed on the cassette to indicate the direction of the axis of the X-ray tube. The tube current (mA) is adjusted to obtain a net density of 1.0. The exposed films shall be developed under standard conditions and inspected on a standard viewing box for the presence of any artifact.

B-3.13 Check for Uniformity

The density of the exposed and developed film shall be measured along the direction of the axis of the X-ray tube and perpendicular to the axis. The maximum deviation from the mean density along the direction of the axis and along the direction perpendicular to the axis shall be noted.



Average gradient = tan θ

FIG. 3 TYPICAL SENSITOMETRIC (H & D) CURVE

ANNEX C

(*Clause* 4.10)

DETERMINATION OF RADIOGRAPHIC REQUIREMENTS SUCH AS CONTRAST, IMAGE CLARITY AND SHARPNESS

C-1 DETERMINATION OF CONTRAST

C-1.1 General

Contrast is here defined as the change in density produced by an aluminium modulator divided by the thickness of the modulator, in mm.

C-1.2 Apparatus

C-1.2.1 *X-Ray Sensitometry (see* **B-2.1***)*

C-1.2.2 *Modulators*

For the measurement of contrast modulators consisting of 10 mm × 10 mm size and 6 mm thick aluminium (1100 alloy) shall be used for techniques (iii) and (iv) shown in Table 2. For techniques (i), (ii) and (v) in Table 2 aluminium blocks of same size but 3 mm thickness shall be used. Modulators are to be placed 1 cm apart in a square array around the central X-ray beam on the tube side of the phantom for high scattering condition (without grid). For exposure under low scatter conditions (with grid) the modulators are placed on the cassette (*see* Fig. 4).

C-1.3 Procedure

The average density under four modulators is subtracted from the average densities measured at 5.0 mm distance away from each modulator on all four sides. This difference is divided by the thickness of the modulators, in millimetres. The contrast is evaluated both for low scatter and high scatter conditions.

C-2 DETERMINATION OF SHARPNESS AND IMAGE CLARITY

C-2.1 General

Sharpness is usually referred to as resolution measured in terms of line pair/mm (lp/mm), which can be clearly visible. Since photographic emulsions are capable of resolving 5 000 lp/mm the effect of unsharpness produced by film is negligible. However a film having 4 lp/mm can transfer most of the information at low and high frequencies. Such a film is suitable for a general radiography department.

C-2.2 Apparatus

C-2.2.1 *X-Ray Sensitometry (see* **B-2.1***)*

C-2.2.2 *X-Ray Test Pattern* — To check the resolution of the system an X-ray test pattern having up to 5 lp/mm shall be used.

C-2.2.3 *Standard Viewing Box* — Luminance 4 000-6 000 lux.

C-2.3 Procedure

X-ray test pattern having at least up to 5-lp/mm frequency is exposed keeping it over the test object in the scatter conditions for each of the exposure conditions as mentioned in Table 2. At least 4 lp/mm could be seen with bare eye when the processed and dried film is viewed on standard viewing box (4 000-6 000 lux). Even though it is the system resolution that is indicated it is also a measure of the resolution capabilities of the film used.

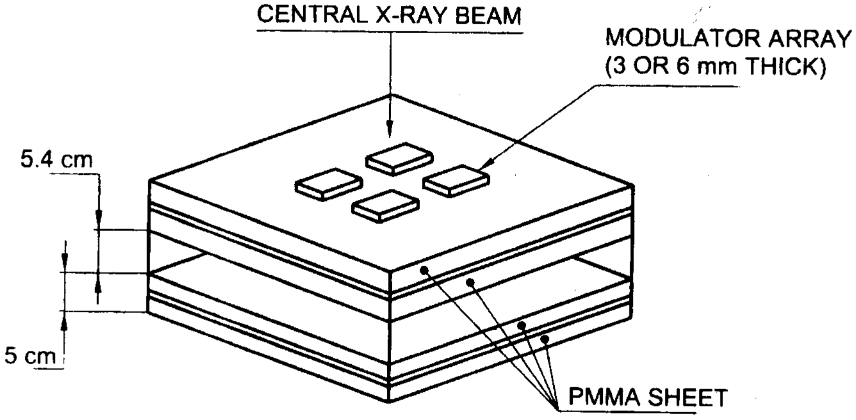


FIG. 4 MODULATORS ON PHANTOM

ANNEX D

(*Clause* 6)

SAMPLING OF MEDICAL X-RAY FILM

D-1 SCALE OF SAMPLING AND NUMBER OF TESTS

D-1.1 Lot

All the films in sheet form produced under similar conditions and of the same size shall be put together to constitute a lot for the requirement under **4.1** to **4.6** and Table 1, Sl No. (i).

D-1.1.1 In order to ascertain the conformity of lot to the requirements of the specification, the sample shall be tested for various characteristics as stated under **D-1.1**.

D-1.1.2 The number of films to be selected to form a lot shall, be in accordance with col 2 and 3 of Table 3.

D-1.1.3 The selection of packets form the lot and sheets from the packets shall be done at random and in order to ensure the randomness of selection the procedures given in IS 4905 may be followed.

D-1.1.4 From the selected packages in accordance with col 2 and 3 of Table 3 approximately same number of sheets shall be selected at random from the packages so as to obtain required number of sheets as given in col 3 of Table 3.

D-1.2 Criteria for Conformity

All the sheets drawn in **D-1.1.3** shall be tested for the requirement under **4.1** to **4.6** and Table 1, Sl No. (i). If any of the sheets fails to satisfy any of these requirements, it shall be termed as defective. The lots shall be declared as conforming to the requirement of the specification if the number of defectives is equal to and less than the number given in col 5 of Table 3.

Table 3 Number of Films to be Selected for Sampling

(*Clauses* D-1.1.2 *and* D-1.2)

Sl No. (1)	Lot Size (Packets) (2)	No. of Packets to be Selected (3)	No of Films to be Selected (4)	Acceptance Number (5)
i)	Up to 15	2	8	0
ii)	16 to 25	3	13	1
iii)	26 to 100	5	20	1
iv)	101 and above	8	32	2

D-2 SAMPLE FOR SENSITOMETRIC AND RADIOGRAPHIC TEST

D-2.1 Lot

Jumbo roll shall constitute a lot/batch.

D-2.2 From each batch three specimen films shall be collected from any two packets selected at random. These samples shall be tested for the requirement as given in Table 1, Sl No. (ii) to (v) and in **4.9** to **4.11**. The individual test results for each batch shall meet the requirements of this specification.

ANNEX E
(*Foreword*)

COMMITTEE COMPOSITION

Inorganic Chemicals and Photographic Materials Sectional Committee, CHD 1

Organization	*Representative(s)*
Central Salt and Marine Chemicals Research Institute (CSMCRI), Bhavnagar	Dr P. K. Ghosh ***(Chairman)***
Alkali Manufacturers' Association of India, New Delhi	Smt Harjeet Kaur Anand
Ballarpur Industries Limited, Uttar Kannaca	Dr V. V. Savant Dr R. S. Ramachandra (*Alternate*)
Bharat Electronics Limited, Bangalore	Shri N. Ravi Bhusan Dr R. C. Sethi (*Alternate*)
Central Electrochemical Research Institute, Karaikudi	Dr (Smt) Sobha Jayakrishnan
Central Salt and Marine Chemicals Research Institute (CSMCRI), Bhavnagar	Dr R. S. Shukla
Central South Gujarat Salt Manufacturers' Association, Gujarat	Shri Parag Sheth
Chemplast Sanmar Limited, Mettur Dam	Shri M. Sivasubramanian
Dharamsi Morarji Chemical Co Ltd, Ambernath	Shri H. V. Rao Dr S. P. Bhattacharya (*Alternate*)
Geological Survey of India, Kolkata	Dr D. K. Das Dr Subhash Chandra (*Alternate*)
Golden Chemicals Limited, Mumbai	Dr P. G. Pradhan Shri Vijay Holihosour (*Alternate*)
Gujarat Alkalies and Chemicals Ltd, Vadodara	Shri H. G. Naik
Hindustan Lever Ltd, Mumbai	Dr V. Krishnan Dr A. Pramanik (*Alternate*)
Hindustan Photo Films Mfg Co Ltd, Ootacamund	Shri Anand Hippalgaonkar
Indian Chemicals Manufacturers' Association, Mumbai	Representative
Indian Institute for Chemical Technology, Hyderabad	Representative
Ministry of Defence (DGQA), Kanpur	Shri S. S. Rao Shri R. S. Diwakar (*Alternate*)
Ministry of Defence (R & D), New Delhi	Col J. C. Mehta
National Chemical Laboratory, Pune	Dr A. A. Natu
National Mineral Development Corporation, Hyderabad	Shri M. Prasad Shri N. C. Lakshman (*Alternate*)
National Physical Laboratory, New Delhi	Dr A. K. Agarwal Dr Prabhat K. Gupta (*Alternate*)
National Test House, Kolkata	Dr S. Rahut Dr Y. C. Najhawan (*Alternate*)
Office of Development Commissioner, Small Scale Industries, New Delhi	Shri S. P. Singh Dr J. S. Rekhi (*Alternate*)
RDSO, Lucknow	Representative
Ronuk Industries Ltd, Mumbai	Smt R. K. Shah
Saurashtra Chemicals, Porbandar	Shri S. C. Sharma Shri M. M. Nigam (*Alternate*)
Shriram Institute for Industrial Research, Delhi	Smt Laxmi Rawat Shri B. Gobindan Nair (*Alternate*)
Standard Alkali (Chemical Division), Mumbai	Shri V. K. Kapur Shri S. N. S. Giri (*Alternate*)

Organization	*Representative(s)*
Tamilnadu Petroproducts Ltd, Chennai	Ch. Hanumantha Rao
Tata Chemicals Ltd, Mithapur	Dr D. D. Kumta
BIS Directorate General	Dr U. C. Srivastava, Director & Head (Chem) [Representing Director General (*Ex-officio Member*)]

Member Secretary
Shri P. Ghosh
Scientist E (Director) (Chem), BIS

Panel for Medical X-Ray Films, CHD 1 : P1

Directorate General of Supplies and Disposals, New Delhi	Shri J. K. Khanna **(*Convener*)**
Agfa India Pvt Ltd, Chennai	Shri K. S. Harinath Shri Tarit Mukhopadhyay (*Alternate*)
Apollo Hospital, Chennai	Representative
Atomic Energy Regulatory Board, Mumbai	Representative
Bhabha Atomic Research Centre, Mumbai	Dr C. P. R. Nair
Breach Candi Hospital, Mumbai	Representative
Computer Graphics Ltd, Chennai	Shri Laljee Asthana Shri R. Natasanan (*Alternate*)
Directorate General of Health Services, New Delhi	Representative
Eco X-Ray and Imaging Institute, Kolkata	Dr S. K. Sharma
GTB Hospital, Delhi	Dr Satish Kumar Bhargav
Hindustan Photo Films Mfg Co Ltd, Ootacamund	Shri Anand Hippalgaonkar Shri G. L. Narasimhan (*Alternate*)
Indian Radiological and Imaging Association, New Delhi	Dr S. S. Dora Dr O. P. Bhardwaj (*Alternate*)
INMAS, Delhi	Dr Ravi Kashyap
Jindal Photo Films Ltd, New Delhi	Shri V. Chinnappan Shri G. Sethu (*Alternate*)
Kodak India Ltd, Mumbai	Shri Rajiv R. Mehta Dr Girish Dixit (*Alternate*)
Lok Nayak Jai Prakash Narayan Hospital, MAMC College & Association, New Delhi	Dr Veena Chowdhury Dr Gaurav S. Pradhan (*Alternate*)
Madras Medical College, Chennai	Dr K. Thayalan
Meditronics Corporation, New Delhi	Smt Meena Mathur Shri Rajender Prasad (*Alternate*)
Ministry of Defence (DGQA), Kanpur	Shri A. K. Sinha Shri B. L. Verma (*Alternate*)
Nizam Institute of Medical Centre, Hyderabad	Dr K. Subha Rao
Post Graduate Institute of Medical Education and Research, Chandigarh	Dr (Smt) Sudha Suri Dr (Smt) Madhu Gulati (*Alternate*)
Railway Hospital, Chennai	Representative
Reference Research Hospital, New Delhi	Representative
Seimen India Ltd, New Delhi	Representative

(Continued from second cover)

ANSI PH2.43 - 1982 Method for the sensitometry of medical X-ray screen-film-processing systems

ANSI PH2.48 - 1981 Method for the sensitometry of medical and dental X-ray film used with fluorescent screens

The composition of the Committee responsible for formulation of this standard is given at Annex E.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*).' The number of significant places retained in the rounded off value should be the same as that of specified value in this standard.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act,* 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc : No. CHD 1 (1074).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones : 2323 01 31, 2323 33 75, 2323 94 02

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices :		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	2323 76 17 2323 38 41
Eastern	: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700 054	2337 84 99, 2337 85 61 2337 86 26, 2337 91 20
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160 022	260 38 43 260 92 85
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600 113	2254 12 16, 2254 14 42 2254 25 19, 2254 23 15
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400 093	2832 92 95, 2832 78 58 2832 78 91, 2832 78 92

Branches : AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. NALAGARH. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

Printed at Prabhat Offset Press, New Delhi-2